Public reporting burden for this of	collection of information is estin	nated to average 1 hour per response	onse, including the time for review	ving instructions, se	earching existing data sources, gathering and	
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MEMORANDUM FOR PRS (In-House Publication)

FROM: PROI (STINFO)

24 April 2002

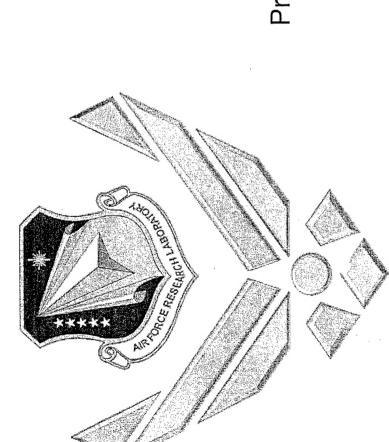
SUBJECT: Authorization for Release of Technical Information, Control Number: AFRL-PR-ED-VG-2002-087
Brent Viers (PRSM), "Thin Film Properties of POSS"

SAMPE Presentation

(Statement A)

(Long Beach, CA, 10-16 May 2002) (Deadline: 16 May 2002)

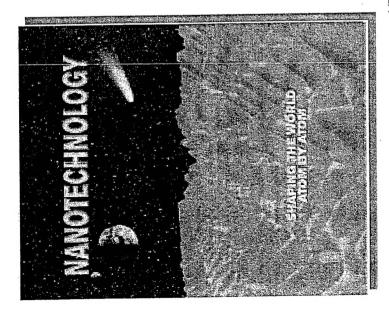
Thin Film Properties of POSS

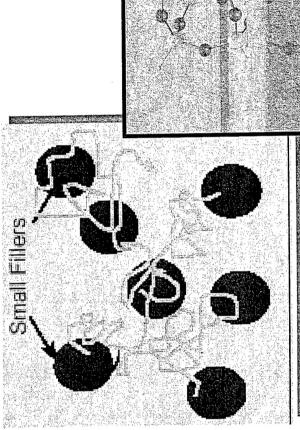


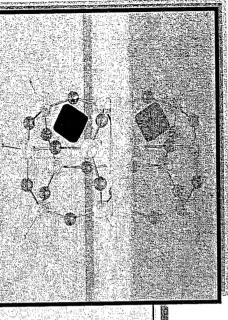
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Dr. Brent Viers
POSS Polymer Group Leader
Air Force Research Laboratory
Propulsion Materials (AFRL/PRSM)
Brent.viers@edwards.af.mil

Inorganic-Organic Hybrids = Nanotechnology







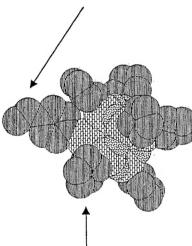
National Nanotechnology Initiative http://www.nano.gov

"Perpetual Plastics: By adorning the polymer structure of synthetic plastic with ceramic nanoparticles, researchers hope to develop new substances that will last far longer"

Mark Gordon, Iowa State U

POSS=polyhedral oligomeric silsesquioxane

Nonreactive organic (R) groups for solubilization and compatibilization.



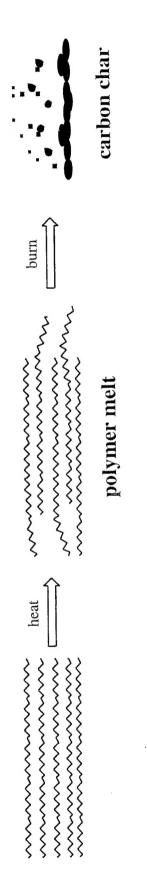
May possess one or more functional groups suitable for polymerization or grafting.

$$Si - Si = 5.4 \text{ Å}$$

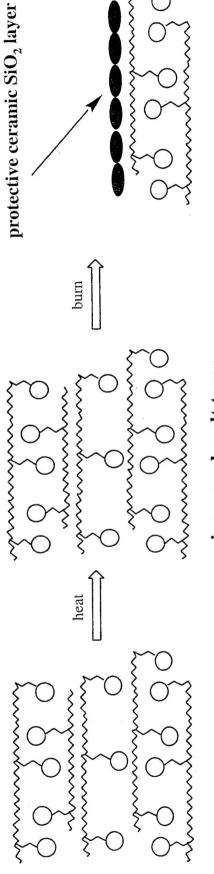
 $Cp - Cp = 15 \text{ Å}$

POSS for Low Ablation Materials

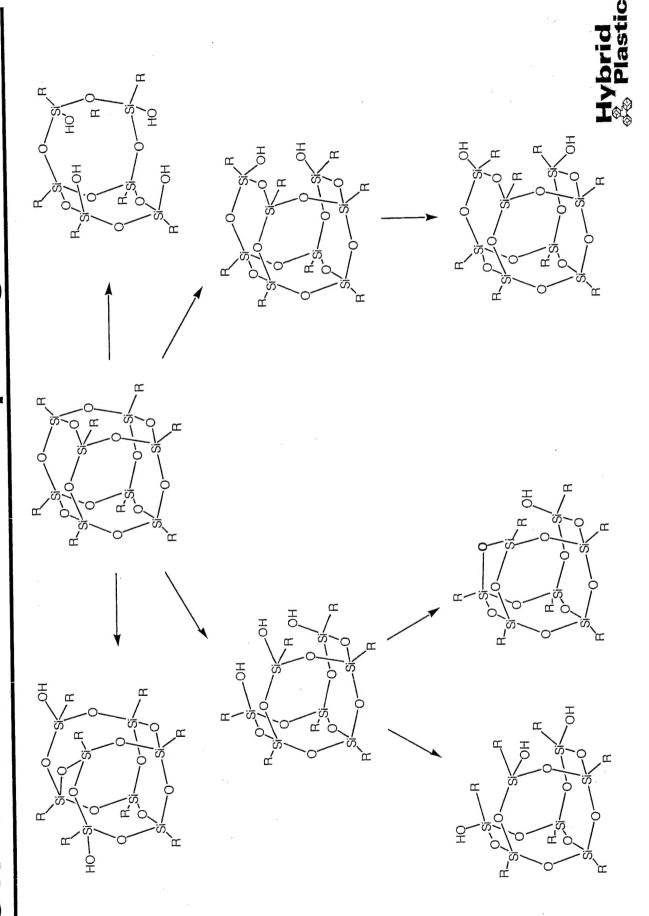
Traditional Polymer



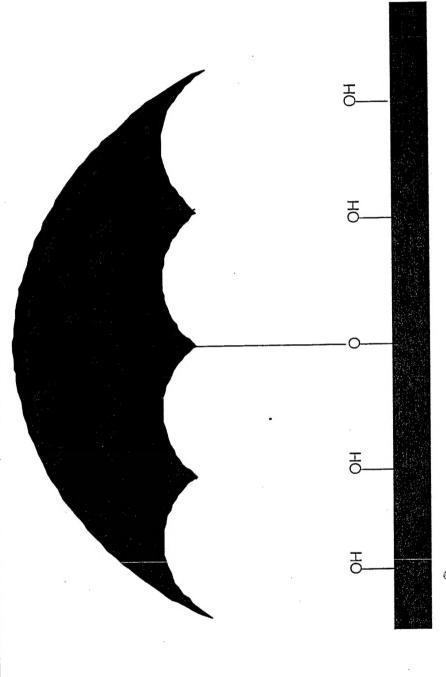
POSS Polymer



increased melt temp



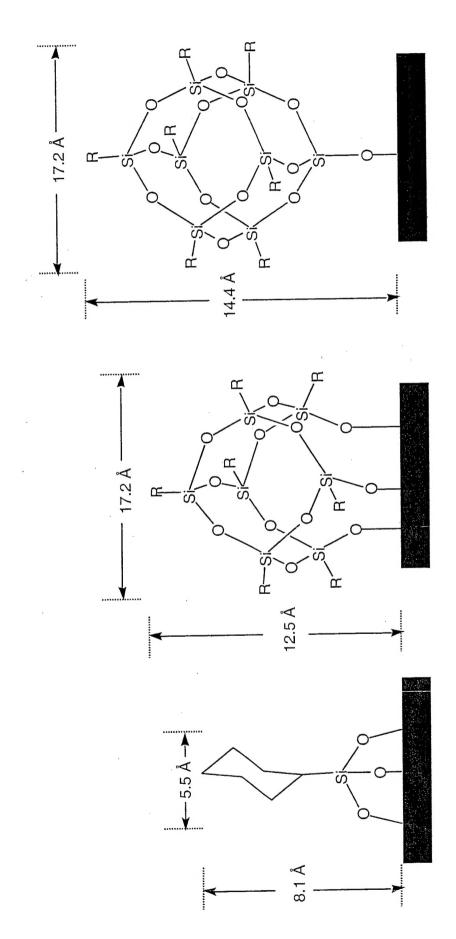
POSS™: The Hydrophobic "Umbrella"



- ➤ POSS™ acts athydrophobic "umbrella" covering surface Si-OH groups (Approx. 10-12 Si-OH groups/POSS™ nanostructure)
- The surface coverage provided by a single POSSTM cage is approximately 8-10X that provided by a typical silane. (2.32 nm 2 vs. 0.24 nm 2)



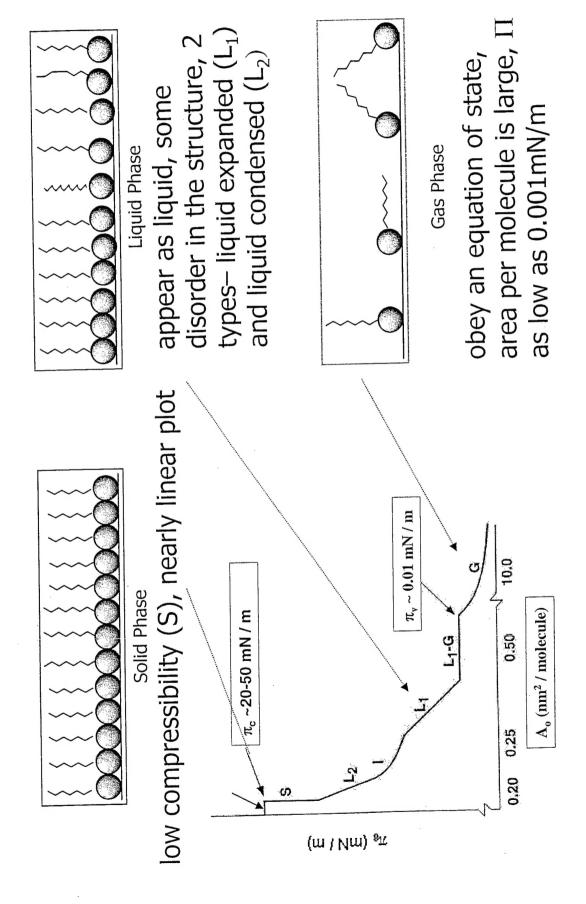
Silanes vs. POSS™: Monolayer Comparison



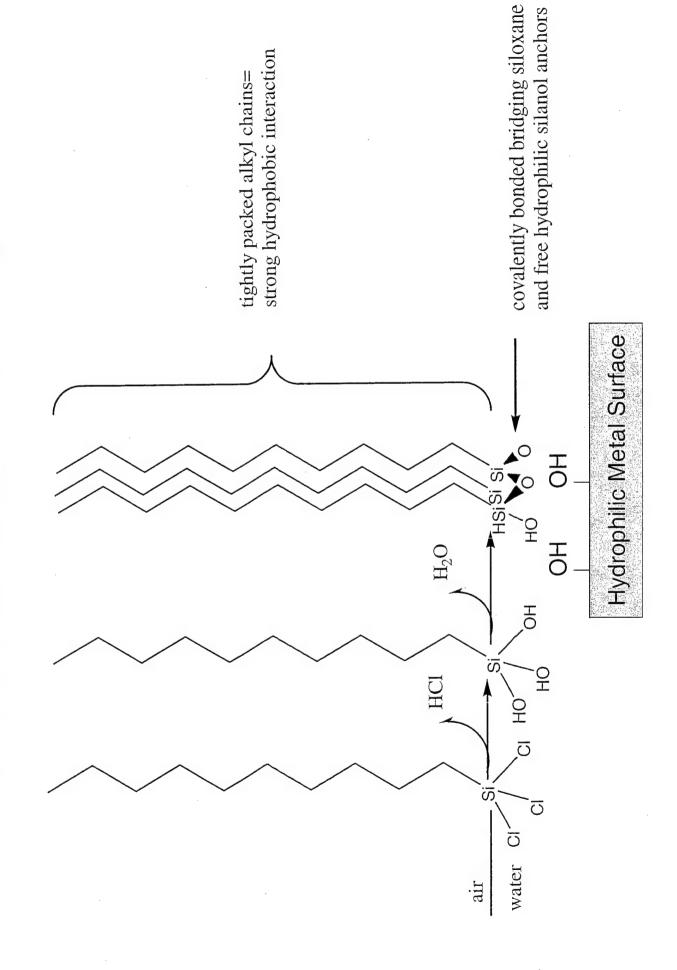
- The well-defined polyhedral structure leads to a more well-ordered, regular surface.
- POSS™ cages provide increased surface coverage leading to a more hydrophobic surface. A



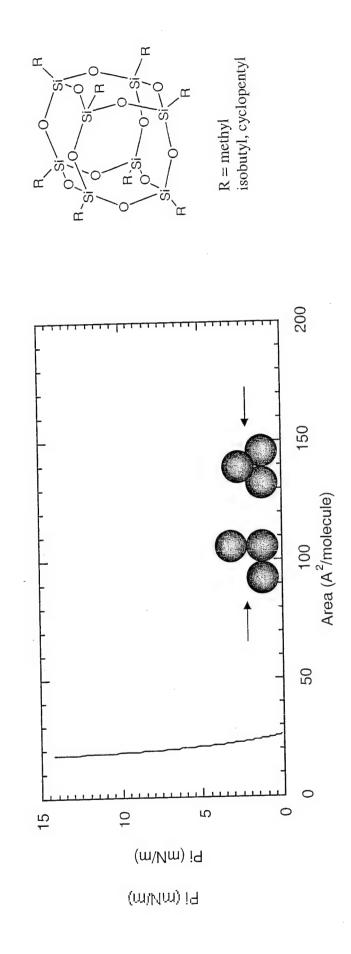
States of Monolayer Films



Chlorosilane Self Assembled Monolayers

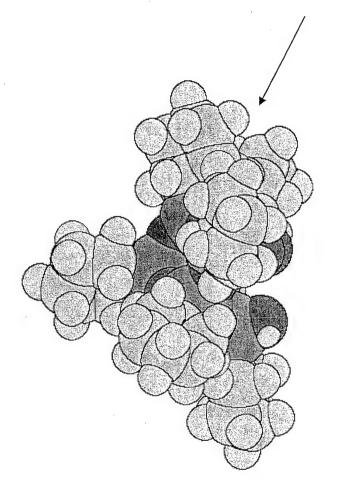


Fully Condensed POSS Cubes

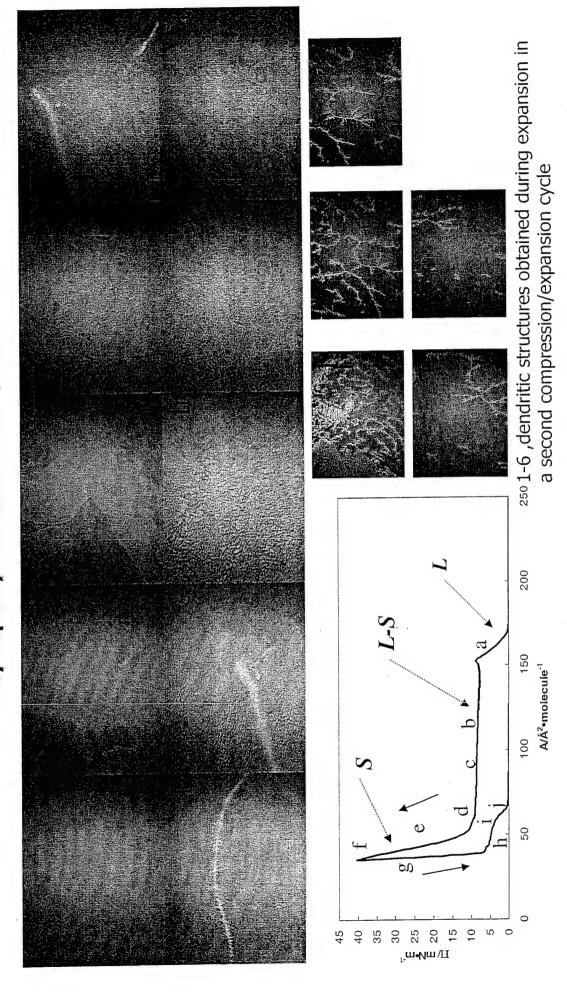


POSS likely exists as aggregates that agglomerate upon compression

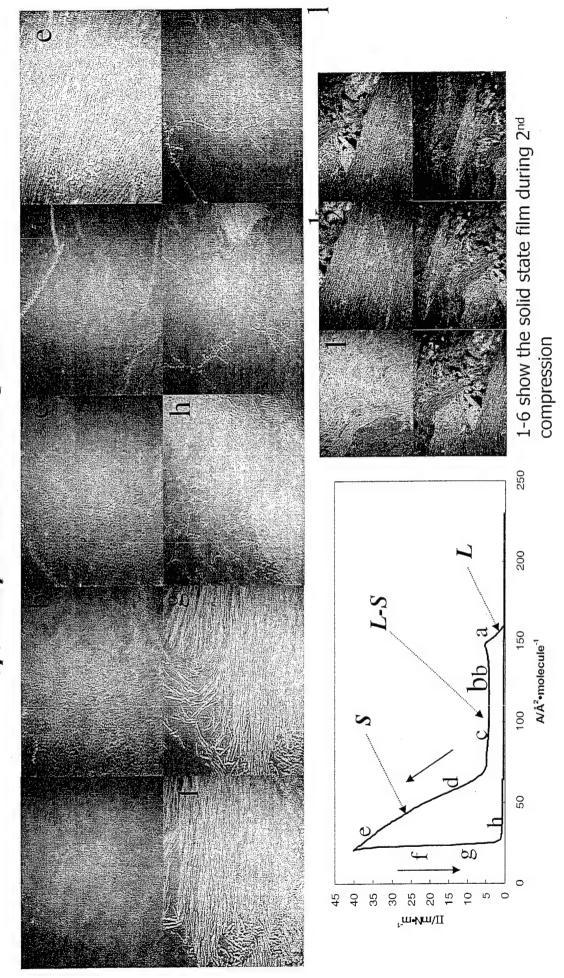
Steric Hindrance of POSS



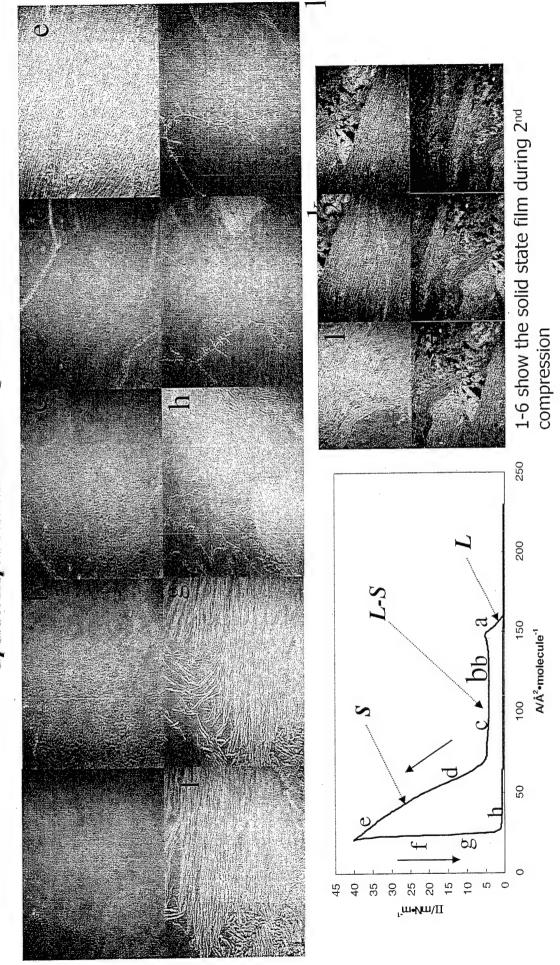
Hydrophobic Organic groups Extend past Hydrophilic Silanols!



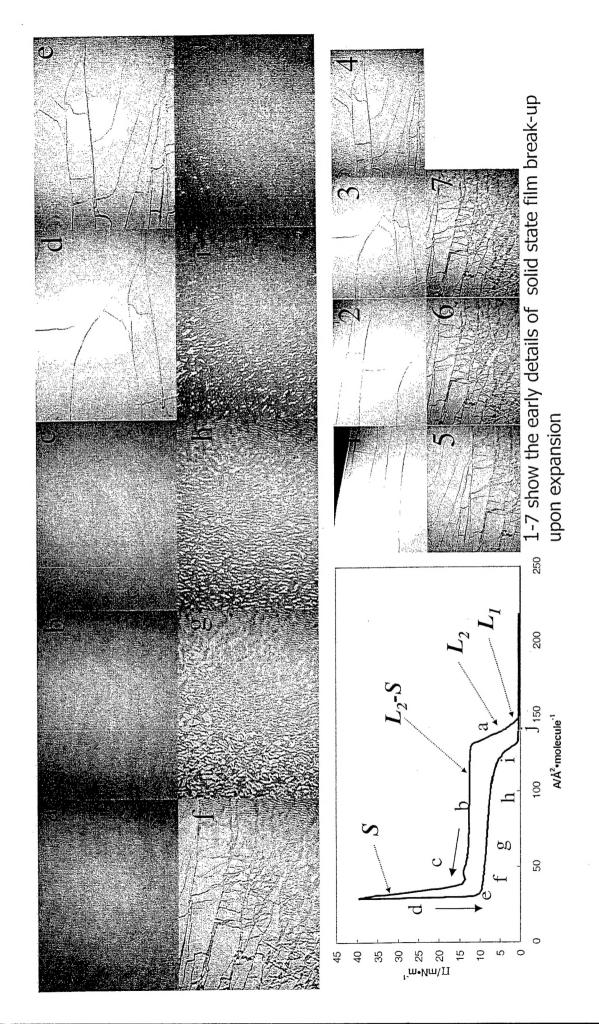
Cyclohexyltrisilanol-POSS @ 22,5°C



Cyclohexyltrisilanol-POSS @ 22.5°C



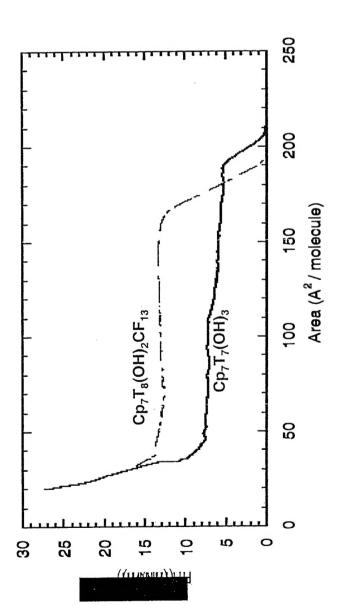
Phenyltrisilanol-POSS @ 22.5°C



POSS in a "traditional" surfactant

Quantitative substitution of first silanol

R = cyclopentyl



Pressure-Area behavior is very similar to POSS precursor

Conclusions

- POSS with hydrophilic silanol groups can spread to form monolayers on a water surface
- Different POSS geometries (functionality) can change the compression behavior in a Langmuir Blodgett apparatus
- behavior which likely affects the filler behavior (vis a vis POSS surfactants can have complicated collapse aggregation effects)
- Transfer experiments are underway



Acknowledgments

- Phillips, Rusty Blanski, Tim Haddad, Brian POSS group at AFRL-Edwards (Shawn Moore, Justin Leland, Pat Ruth, Capt. Rene Gonzalez, Maj. Steve Svejda)
- Hybrid plastics (Joe Lichtenhan, Joe Schwab, Bill Reinerth)
- AFOSR (Dr. Charles Lee), Edwards AFRLpropulsion directorate